

## Biology

State Standard Number	State Standard Area/Description	Unit Name	Course Topic Description
4.9-11 LS	Life Science		
4.9-11 LS1	Processes Within Cells		
4.9-11 LS1A	Carbon-containing compounds are the building blocks of life. Photosynthesis is the process that plant cells use to combine the energy of sunlight with molecules of carbon dioxide and water to produce energy-rich compounds that contain carbon (food) and release oxygen.		
4.9-11 LS1A.1	Explain how plant cells use photosynthesis to produce their own food. Use the following equation to illustrate how plants rearrange atoms during photosynthesis: $6\text{CO}_2 + 6\text{H}_2\text{O} + \text{light energy} \rightarrow \text{C}_6\text{H}_{12}\text{O}_6 + 6\text{O}_2$	Photosynthesis	Section 2 Part 1 Photosynthesis: Food Production
4.9-11 LS1A.2	Explain the importance of photosynthesis for both plants and animals, including humans.	Photosynthesis	Section 2 Part 1 Photosynthesis: Food Production
4.9-11 LS1B	The gradual combustion of carbon-containing compounds within cells, called cellular respiration, provides the primary energy source of living organisms; the combustion of carbon by burning of fossil fuels provides the primary energy source for most of modern society.		
4.9-11 LS1B.1	Explain how the process of cellular respiration is similar to the burning of fossil fuels (e.g., both processes involve combustion of carbon-containing compounds to transform	Photosynthesis	Section 3 Part 1 Cellular Respiration

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	chemical energy to a different form of energy).		
4.9-11 LS1C	Cells contain specialized parts for determining essential functions such as regulation of cellular activities, energy capture and release, formation of proteins, waste disposal, the transfer of information, and movement.		
4.9-11 LS1C.1	Draw, label, and describe the functions of components of essential structures within cells (e.g., cellular membrane, nucleus, chromosome, chloroplast, mitochondrion, ribosome)	Cell Structure	Section 1 Part 5 Cell Features: Common Features of Cells
4.9-11 LS1D	The cell is surrounded by a membrane that separates the interior of the cell from the outside world and determines which substances may enter and which may leave the cell.		
4.9-11 LS1D.1	Describe the structure of the cell membrane and how the membrane regulates the flow of materials into and out of the cell.	Cell Structure	Section 2 Part 1 The Cell Membrane: Structure and Function
4.9-11 LS1E	The genetic information responsible for inherited characteristics is encoded in the DNA molecules in chromosomes. DNA is composed of four subunits (A,T,C,G). The sequence of subunits in a gene specifies the amino acids needed to make a protein. Proteins express inherited traits (e.g., eye color, hair texture) and carry out most cell function.		
4.9-11 LS1E.1	Describe how DNA molecules are long chains linking four subunits (smaller molecules) whose sequence encodes genetic information.	Genetics	Section 4 Part 3 The Structure of DNA

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4.9-11 LS1E.2	Illustrate the process by which gene sequences are copied to produce proteins.	Genetics	Section 5 beginning with Part 1 Protein Synthesis: From Gene to Protein
4.9-11 LS1F	All of the functions of the cell are based on chemical reactions. Food molecules are broken down to provide the energy and the chemical constituents needed to synthesize other molecules. Breakdown and synthesis are made possible by proteins called enzymes. Some of these enzymes enable the cell to store energy in special chemicals, such as ATP, that are needed to drive the many other chemical reactions in a cell.		
4.9-11 LS1F.1	Explain how cells break down food molecules and use the constituents to synthesize proteins, sugars, fats, DNA and many other molecules that cells require.	Photosynthesis	Section 3 Part 1 Cellular Respiration
4.9-11 LS1F.2	Describe the role that enzymes play in the breakdown of food molecules and synthesis of the many different molecules needed for cell structure and function.	Photosynthesis	Section 1 Part 2 Enzymes: Organic Catalysts
4.9-11 LS1F.3	Explain how cells extract and store energy from food molecules.	Photosynthesis	Section 3 Part 1 Cellular Respiration  Section 1 Part 3 Where Does Energy Come From?
4.9-11 LS1G	Cells use the DNA that forms their genes to encode enzymes and other proteins that allow a cell to grow and divide to produce more cells, and respond to the environment.		
4.9-11 LS1G.1	Explain that regulation of cell functions can occur by changing the activity of proteins within cells and/or by changing whether and how much particular genes are expressed.		

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4.9-11 LS1H	Genes are carried on chromosomes. Animal cells contain two copies of each chromosome with genetic information that regulate body structure and functions. Cells divide by a process called mitosis, in which the genetic information is copied so that each new cell contains exact copies of the original chromosomes.		
4.9-11 LS1H.1	Describe and model the process of mitosis, in which one cell divides, producing two cells, each with copies of both chromosomes from each pair in the original cell.	Cell Structure	Section 3 Part 6 Mitosis: Cell Xeroxing
4.9-11 LS1I	Egg and sperm cells are formed by a process called meiosis in which each resulting cell contains only one representative chromosome from each pair found in the original cell. Recombination of genetic information during meiosis scrambles the genetic information, allowing for new genetic combinations and characteristics in the offspring. Fertilization restores the original number of chromosome pairs and reshuffles the genetic information, allowing for variation among offspring.		
4.9-11 LS1I.1	Describe and model the process of meiosis in which egg and sperm cells are formed with only one set of chromosomes from each parent.	Cell Structure	Section 4 beginning at Part 1 Meiosis and Sexual Reproduction
4.9-11 LS1I.2	Model and explain the process of genetic recombination that may occur during meiosis and how this then results in differing characteristics in offspring.	Cell Structure	Section 4 Meiosis Lab
4.9-11 LS1I.3	Describe the process of fertilization that restores the original chromosome number while reshuffling the genetic information, allowing for variation among offspring.	Cell Structure	Section 4 Part 7 Meiosis and Genetic Variation

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4.9-11 LSII.4	Predict the outcome of specific genetic crosses involving two characteristics.	Genetics	Section 1 Part 6 The Principle of Independent Assortment
4.9-11 LS2	Maintenance and Stability of Populations		
4.9-11 LS2A	Matter cycles and energy flows through living and nonliving components in ecosystems. The transfer of matter and energy is important for maintaining the health and sustainability of an ecosystem.		
4.9-11 LS2A.1	Explain how plants and animals cycle carbon and nitrogen within an ecosystem.	Population Ecology	Section 3 Part 1 The Biosphere And Mass Extinctions
4.9-11 LS2A.2	Explain how matter cycles and energy flows in ecosystems, resulting in the formation of differing chemical compounds and heat.	Population Ecology	Section 3 Part 1 The Biosphere And Mass Extinctions
4.9-11 LS2B	Living organisms have the capacity to produce very large populations. Population density is the number of individuals of a particular population living in a given amount of space.		
4.9-11 LS2B.1	Evaluate the conditions necessary for rapid population growth (e.g., given adequate living and nonliving resources and no disease or predators, populations of an organism increase at rapid rates).	Population Ecology	Section 1 Part 1 Population Growth
4.9-11 LS2B.2	Given ecosystem data, calculate the population density of an organism.		

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4.9-11 LS2C	Population growth is limited by the availability of matter and energy found in resources, the size of the environment, and the presence of competing and/or predatory organisms.		
4.9-11 LS2C.1	Explain factors, including matter and energy, in the environment that limit the growth of plant and animal populations in natural ecosystems.	Population Ecology	Section 3 Part 1 The Biosphere And Mass Extinctions
4.9-11 LS2D	Scientists represent ecosystems in the natural world using mathematical models.		
4.9-11 LS2D.1	Draw a systems diagram to illustrate and explain why introduced (nonnative) species often do poorly and have a tendency to die out, as well as why they sometimes do very well and force out native species.		
4.9-11 LS2E	Interrelationships of organisms may generate ecosystems that are stable for hundreds or thousands of years. Biodiversity refers to the different kinds of organisms in specific ecosystems or on the planet as a whole.		
4.9-11 LS2E.1	Compare the biodiversity of organisms in different types of ecosystems (e.g., rain forest, grassland, desert) noting the interdependencies and interrelationships among the organisms in these different ecosystems.	Population Ecology	Section 2 Part 2 Terrestrial Biomes and Part 3 Climate, Altitude and Terrestrial Biomes
4.9-11 LS2F	The concept of sustainable development supports adoption of policies that enable people to obtain the resources they need today without limiting the ability of future generations to meet their own needs. Sustainable processes include substituting renewable for nonrenewable resources, recycling, and using fewer resources. Sustainable processes include substituting renewable for nonrenewable resources, recycling, and using fewer resources.		

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4.9-11 LS2F.1	Explain how scientific concepts and findings relate to a resource issue currently under discussion in the state of Washington (e.g., removal of dams to facilitate salmon spawning in rivers; construction of wind farms).		
4.9-11 LS2F.2	Explain how the concept of sustainable development may be applied to a current resource issue in the state of Washington.		
4.9-11 LS3	Mechanisms of Evolution		
4.9-11 LS3A	Biological evolution is due to: (1) genetic variability of offspring due to mutations and genetic recombination, (2) the potential for a species to increase its numbers, (3) a finite supply of resources, and (4) selection by the environment for those offspring better able to survive and produce offspring.		
4.9-11 LS3A.1	Explain biological evolution as the consequence of the interactions of four factors: population growth, inherited variability of offspring, a finite supply of resources, and natural selection by the environment of offspring better able to survive and reproduce.	Evolution	Section 1 Part 3 Evolution by Natural Selection
4.9-11 LS3A.2	Predict the effect on a species if one of these factors should change.		
4.9-11 LS3B	Random changes in the genetic makeup of cells and organisms (mutations) can cause changes in their physical characteristics or behaviors. If the genetic mutations occur in eggs or sperm cells, the changes will be inherited by offspring. While many of these changes will be harmful, a small minority may allow the offspring to better survive and reproduce.	Evolution	Section2 Part 2 Mutation Rate

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4.9-11 LS3B.1	Describe the molecular process by which organisms pass on physical and behavioral traits to offspring, as well as the environmental and genetic factors that cause minor differences (variations) in offspring or occasional "mistakes" in the copying of genetic material that can be inherited by future generations (mutations).	Genetics	Section 4 DNA and Section 5 RNA and Protein Synthesis
4.9-11 LS3B.2	Explain how a genetic mutation may or may not allow a species to survive and reproduce in a given environment.		
4.9-11 LS3C	The great diversity of organisms is the result of more than 3.5 billion years of evolution that has filled available ecosystem niches on Earth with life forms.		
4.9-11 LS3C.1	Explain how the millions of different species alive today are related by descent from a common ancestor.	Evolution	Section 1 Part 3 Evolution by Natural Selection
4.9-11 LS3C.2	Explain that genes in organisms that are very different (e.g., yeast, flies, and mammals) can be very similar because these organisms all share a common ancestor.	Evolution	Section 1 Part 4 Evidence for Evolution
4.9-11 LS3D	The fossil record and anatomical and molecular similarities observed among diverse species of living organisms provide evidence of biological evolution.		
4.9-11 LS3D.1	Using the fossil record and anatomical and/or molecular (DNA) similarities as evidence, formulate a logical argument for biological evolution as an explanation for the development of a representative species (e.g., birds, horses, elephants, whales).	Evolution	Section 1 Part 4 Evidence for Evolution

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4.9-11 LS3E	Biological classifications are based on how organisms are related, reflecting their evolutionary history. Scientists infer relationships from physiological traits, genetic information, and the ability of two organisms to produce fertile offspring.	Biological Diversity	Section 1 Part 1 Taxonomy
4.9-11 LS3E.1	Classify organisms, using similarities and differences in physical and functional characteristics.	Biological Diversity	Section 1 Part 1 Taxonomy and lab activities in this Unit
4.9-11 LS3E.2	Explain similarities and differences among closely related organisms in terms of biological evolution (e.g., "Darwin's finches" had different beaks due to food sources on the islands where they evolved).	Evolution	Section 1 Part 4 Evidence for Evolution